4. Answer ***any two*** from the following question: 10×2=20

*a.* Evaluate $\int_0^2 \frac{dx}{x^3+x+1}$ by Simpson's $\frac{3}{8}$ rule with $h$=0.25.

*b.* Apply Runge-Kutta method to find approximate value of $y$ when $x$=1.4, given that $\frac{dy}{dx} = xy$, taking $y(1)$=2, $h$=0.2.

*c.* For the data,

| $x$: | −4 | −2 | 0 | 2 | 4 | 6 |
|---|---|---|---|---|---|---|
| $y=f(x)$ | −139 | −21 | 1 | 23 | 141 | 451 |

construct forward and backward differences tables. Using the corresponding interpolation, show that the interpolating polynomial is same.

*d.* Use the Secant method to estimate the root of the equation, $x^2-4x-10=0$, with the initial estimates of $x_1$=4 and $x_2$=2.





**63/1(SEM–5) DSE2/BCAHE5026**

**2024**

# COMPUTER APPLICATION

Paper : BCAHE5026

***( Numerical Methods )***

*Full Marks : 60*

*Pass Marks : 24*

Time : Three hours

***The figures in the margin indicate full marks for the questions.***

1. Choose the correct answer from the following : ***(any five)*** 1×5=5

*a.* In which of the following methods, we approximate the curve of solution by the tangent in each interval ?

*i.* Picard's method

*ii.* Euler's method

*iii.* Newton's method

*iv.* Runge-Kutta method

*Contd.*

b. A floating-point number is said to be normalized, if the most significant bit of the mantissa is—

i. 1

ii. 0

iii. –1

iv. 2

c. Which of the following is an iterative method ?

i. Gauss-Seidel

ii. Gauss-Jordan

iii. Factorization

iv. Gauss-Elimination

d. Which of the following statements applied to the bisection method is used for finding roots of functions ?

i. Converges within a few iterations

ii. Guaranteed to work for all continuous functions

iii. Is faster than the Newton-Raphson method

iv. Requires that there will be no error in determining the sign of the function



e. If $\Delta f(x) = f(x+h) - f(x)$, then a constant $k$, $\Delta k$ equals—

i. 1

ii. 0

iii. $f(k) - f(0)$

iv. $f(x+k) - f(x)$

f. Use the Midpoint method to approximate $y(0.1)$ where $y' = t2 + y2, y(0) = 0$.

i. 0.00052

ii. 0.00025

iii. 0.0052

iv. 0.0025

g. By Trapezoidal rule $\int_0^2 e^x dx$ is—

i. 6.389

ii. 4.164

iii. 8.389

iv. 6.421

h. Approximate solution of the set of equations, $2x+2y-z=6$, $x+y+2x=8$ and $-x+3y+2z=4$, is given by $x=2.8$, $y=1$ and $z=1.8$. Then, what is the exact solution ?

i. $x=1,\ y=3,\ z=2$

ii. $x=2,\ y=3,\ z=1$

iii. $x=3,\ y=1,\ z=2$

iv. $x=1,\ y=2,\ z=2$

i. What is the iteration formula of Secant method ?

i. $P_n = P_{n-1} - \dfrac{f(P_{n-2})(P_{n-1} - P_{n-2})}{f(P_{n-1}) - f(P_{n-2})}$

ii. $P_n = P_{n-2} - \dfrac{f(P_{n-1})(P_{n-1} - P_{n-2})}{f(P_{n-1}) - f(P_{n-2})}$

iii. $P_n = P_{n-1} - \dfrac{f(P_{n-1})(P_{n-1} - P_{n-2})}{f(P_{n-1}) - f(P_{n-2})}$

iv. $P_n = P_{n-2} - \dfrac{f(P_{n-2})(P_{n-1} - P_{n-2})}{f(P_{n-1}) - f(P_{n-2})}$



j. The error that is produced when a calculator or computer is used to perform real number calculations is called—

i. Round-off error

ii. System error

iii. Mechanical error

iv. None of these

2. Answer the following questions : ***(any five)*** 2×5=10

a. Add the number 0.735816E4 and 0.635742E4 and divide the number 0.876543E-5 by 0.200000E-3.

b. Which of the following numbers has the greatest precision ?

4.3201, 4.32 and 4.320106.

c. Using Newton's backward difference formula, write the formulae for the first and second order derivatives at the end of value $x=x_n$ upto the fourth order difference term.

d. Evaluate $\Delta^2 (e^{ax+b})$

e. Solve the system of equations $x-2y=0$ and $2x+y=5$ by direct method.

f. When is Newton's Backward interpolation formula used? Give the Newton's divided difference formula.

g. Convert the following numbers to floating point notation:

0.00596, 65.7452 and −486.8.

3. Answer ***any five*** from the following questions: 5×5=25

a. For $x=0.4845$ and $y=0.4800$, calculate the value of $\frac{x^2-y^2}{x+y}$ using normalized floating-point arithmetic.

b. What do you mean by numerical errors? Briefly describe about the different forms of numerical errors.

c. Solve the equations using Gauss Elimination method.

$x_1+x_2-x_3=2$, $2x_1+3x_2-5x_3=1$, $4x_1-5x_2-7x_3=5$ using pivoting considerations.

d. Using Lagrange's formula, fit a polynomial to the following data.

| $x$ | 0 | 1 | 3 | 4 |
|---|---|---|---|---|
| $y$ | −12 | 0 | 6 | 12 |



e. Perform four iterations of Jacobi's iteration method to solve the system of equation, $\begin{bmatrix}4&1&2\\1&5&1\\2&1&4\end{bmatrix}X=\begin{bmatrix}-1\\5\\3\end{bmatrix}$

f. Find the truncation error in the result of the following function for $x=\frac{1}{5}$ when we use,

(i) First three terms

(ii) First four terms and

(iii) First five terms

g. Discuss about the Romberg Integration and Gaussian quadrature method.

h. Evaluate $\int_0^{0.8} e^{-x^2}dx$ by Romberg's method with $h=0.1$

i. Find a positive root of the equation $x - \sin x=\frac{1}{2}$; using Bisection method where roots are lied in the interval [0,1].